

# A survey of the attributes and requirements of quolls that may affect their suitability as household pets

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## ABSTRACT

A questionnaire, sent to scientists and wildlife attendants/carers known to have extensive experience handling quolls *Dasyurus* spp., was designed to assess those attributes and requirements of quolls which may affect their suitability as pets. Twenty people contributed. Overall, it appeared that essential dietary components were readily available, housing was simple, quolls were rarely demanding on time, mostly healthy and rarely stressed. Specialist attention (e.g., veterinary) was only required occasionally and no adverse human health effects were observed. Responses varied greatly regarding ease of handling, aggression, odour, property damaging behaviour and fecundity. Management history of individual animals affected responses; quolls kept as house pets (rather than permanently caged) elicited the most positive responses on the suitability of quolls as pets.

Key words: Quoll, Pet, Dasyuridae, *Dasyurus*, Northern Quoll, Eastern Quoll, Western Quoll, Chuditch, Spotted-tailed Quoll.

## INTRODUCTION

People keep pets, or companion animals, for a variety of reasons. Debate centres not so much on pet keeping but rather the suitability of various species (and breeds) as pet animals. Dog attacks on children and cat predation on native animals have been of particular concern. Another contentious area is whether the mix of species kept in urban areas should be expanded to include selected Australian native mammals. Some people believe that including native species may have indirect conservation benefits by increasing public awareness of and empathy with wildlife. Others are concerned that native species as pets would not be properly cared for and that the escape of "domestic" native mammals would adversely affect wild populations.

Quolls (genus *Dasyurus*) are carnivorous marsupials; four species are found in Australia and two in New Guinea. Of the four Australian species, the Spotted-tailed Quoll is the largest, with adult males weighing on average 3–4 kg (Jones and Barmuta 1998). The Western (also known as chuditch) and Eastern Quolls are smaller, weighing a maximum of 1.3 kg (Serena and Soderquist 1995; Godsell 1995). The Northern Quoll is the smallest species, weighing up to 1.2 kg (Oakwood 1997). All quolls have distinctive white-spotted fur with the background fur colour being various shades of brown and/or black depending on the species. All Australian quoll species have declined since European settlement, a dramatic example being the

Eastern Quoll which although "one of the commonest of all the bush animals" in the 1850s (Wheelwright 1979) is now extinct in the wild on the mainland (Jones 1996). Eastern Quolls used to be abundant in the eastern suburbs of Sydney between 1915 and 1929 (Wiseman 1945). The last known individual collected in New South Wales came from Vacluse, Sydney in 1963 (Australian Museum Collection; Godsell *et al.* 1984). Now in Sydney, only a few individuals exist (albeit probably of Tasmanian origin), and these are in zoos and wildlife parks.

Although quolls were often persecuted by people in the past due to threats to poultry and food stores, they were also described very favourably as pets in the older literature, and were allowed free run of the house in the evenings (Fleay 1945; Troughton 1954; Bonnin 1967). In recent decades due to reduced abundance of quolls and legislation preventing them being kept, many people are totally unaware of the existence of quolls. Those who still encounter quolls in rural areas, often kill them. Perhaps if quolls were currently able to be kept as pets, there could be an improvement in their public image which may reduce persecution. Additionally, public demand for captive bred quolls could be used to support separate captive breeding programmes for reintroduction into the wild.

This paper summarizes a survey of the observations and opinions of 20 scientists and wildlife carers with experience of handling quolls, on the suitability of quolls as pets.

Apart from noting respondent's comments, we do not attempt to address conservation or philosophical issues surrounding the keeping of native species as pets.

## METHODS

A questionnaire designed to assess a range of characteristics which affect the suitability of a species to be kept as pets was sent in 1996/1997 to all people known to the primary author who had either kept quolls in captivity or conducted a specific study on quolls in the wild. Forty wildlife attendants/carers and scientists were known to have extensive experience with quolls. Although ideally it would be preferable to survey only people who had actually kept quolls as pets, with current Australian legislation, few quolls are kept in this situation. The format was largely multiple choice questions. Each question is given in the results section, with the corresponding figure depicting the percentage responses for each option. Written comments were also invited. Copies of the questionnaire are available on request to the authors.

The sample size of responses to individual questions varied due to experience and inclination of the respondents. In general, data on all four quoll species were pooled for each question as the sample size was too small, and respondent variability too great, to reliably show interspecific variation. Means for ratio data (e.g., costs) are given  $\pm$  one standard deviation.

Respondents also contributed additional information and personal views. These are quoted or paraphrased in the relevant sections with abbreviations to identify the species to which they are referring; STQ = Spotted-tailed Quoll *Dasyurus maculatus*, WQ = Western Quoll *Dasyurus geoffroii*, EQ = Eastern Quoll *Dasyurus viverrinus* and NQ = Northern Quoll *Dasyurus hallucatus*.

## RESULTS

Twenty people responded to the questionnaire, responses coming from all states and territories of Australia. Three respondents commented on two species giving a total of 23 responses. There were four reports on *D. geoffroii*, five on *D. viverrinus*, six on *D. maculatus* and eight on *D. hallucatus*. Five respondents had experience handling only wild caught quolls (three only with quolls living in the wild), four had experience handling only captive bred quolls and 11 had handled both. Three respondents had hand-raised quolls. Four respondents kept quolls in a total or partial house pet situation. Four respondents held no formal zoological

qualifications while the remaining 16 had tertiary qualifications ranging from Technical and Further Education certificates in zoology to PhDs in zoology.

### Handling

*How do you rate the ease or difficulty of catching and holding quolls within their enclosure?*

The modal response was "occasionally difficult" (43%) although the full range from "easy" to "difficult" was reported ( $n = 23$ ; Fig. 1a). The respondents with experience of wild quolls or wild caught quolls in captivity, reported a range from "easy" to "difficult". The eight respondents who just handled captive bred quolls in captivity or kept them as house-pets found them "easy" or "occasionally difficult". Two respondents commented that quolls become more docile with increased handling. One stated that while caged Eastern Quolls are difficult to handle "for all intents and purposes wild animals", hand reared quolls were "delightful to handle". The other noted that "if handled enough both sexes are remarkably docile" (NQ). Two respondents noted that the ease of handling varied greatly between individual quolls (NQ, STQ).

*Do quolls exhibit aggressive behaviour?*

The modal response was "never or rarely" (36%) although the full range of behaviour was reported with 23% "almost always" exhibiting aggressive behaviour ( $n = 22$ ; Fig. 1b). As with the previous question, a dichotomy in the behaviour of wild and caged quolls compared to hand-reared or frequently handled quolls was noted. The five "almost always aggressive" responses referred to wild quolls (2 STQs) and caged quolls. Whereas all four respondents that kept them as house pets found them to be "never or rarely aggressive". Comments such as "caged animals can bite" whereas "hand reared quolls rarely cause injury" (EQ), "only exhibit aggressive behaviour if not handled frequently" (NQ) and "in my experience if they are handled every day this never happens" (being bitten; NQ) reinforce this view.

*If the quoll exhibits aggressive behaviour, how would you rate the outcome of this aggression? State the type of aggressive behaviour and if the aggression is age or sex related.*

The modal response was equally "occasionally cause minor injury" or "frequently cause injury" (Fig. 1c,  $n = 17$ ), these categories accounting for 82% of responses. The least problematic aggressive behaviours listed were "play biting like kittens and puppies. Doesn't break skin." (NQ) and "just small nips if not handled frequently enough" (NQ). One

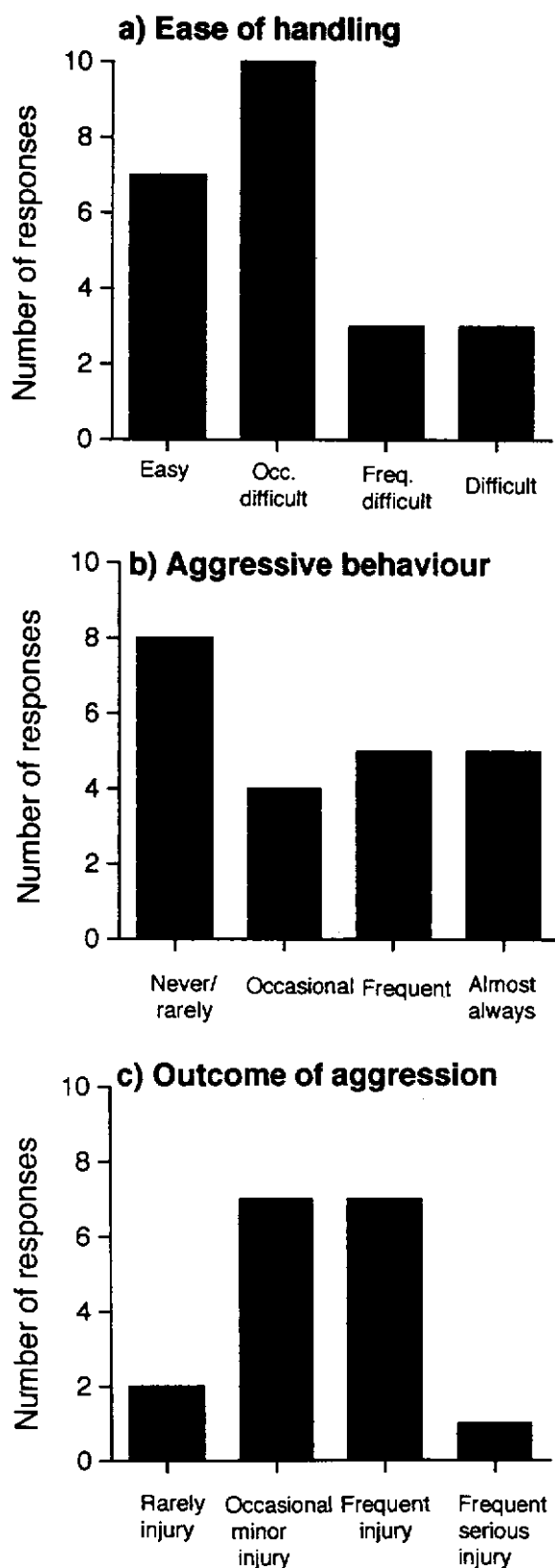


Figure 1. The responses regarding aspects of handling quolls. a) The ease or difficulty of catching and holding quolls within their enclosures (number of responses = 23). b) Whether quolls exhibit aggressive behaviour (e.g., biting, chasing, snarling, lunging; n = 22). c) If aggressive behaviour was observed, then the outcome of this aggressive behaviour (n = 17).

respondent noted that "its ability to hunt is learnt from playful aggressive behaviour" (EQ). Aggressive vocalizations ranged from hissing (NQ, STQ) and a "nark" sound (WQ) to growling (NQ, EQ, STQ) and screeching (STQ). The most aggressive behaviour recorded was threat display with open jaws and bared teeth (STQ), scratching (STQ, WQ), snapping (EQ, STQ), biting (caged EQ, NQ, STQ, WQ), attacking (NQ), lunging (NQ, WQ, STQ) and chasing (STQ). The worst injury reported was a "macerated finger — 3 week recovery period" (WQ) and an additional unfavourable comment was "biting and clawing when handled — the claws are incredibly sharp" (WQ).

To the question of whether aggression was age-related or sex-related, the responses were; no (n = 4), uncertain (n = 3), adults more aggressive than young (n = 4), males more aggressive than females (n = 6) and females with pouch young more aggressive (n = 1). It was also noted that "aggressive behaviour is very much an individual response" (WQ).

#### Diet

*Is there commercially available foodstuffs for this species? If part or all of the diet is not commercially available, could it be made commercially available and would it be likely to be expensive? How much does it cost to feed an individual animal per week?*

The modal response was that all diet components are commercially available (n = 23; Fig. 2a). Although 30% of respondents considered that not all of the essential dietary components were commercially available, those that responded to the second part of the question all considered that the missing foodstuffs could be made available commercially and would be affordable or cheap to produce (n = 5; Fig. 2b).

The mean cost of feeding an individual quoll per week (from those respondents who were able to calculate the cost) was \$5.20 ( $\pm$  \$4.40, n = 5). The other respondents estimated that the mean cost was \$7.17 ( $\pm$  \$4.62, n = 9). As expected, size differences between the species affect cost with the larger STQ (\$11.25  $\pm$  \$5.3, n = 2) costing on average more than the smaller NQ (\$3.86  $\pm$  \$4.22, n = 7). One respondent stated that "it was a house pet and did not cost me anything — it ate anything and everything — fed from our table and also ate mice, insects etc." (WQ). Other comments were "we mostly fed the animals with frozen mice/guinea pigs... Dried dog food was also used" (EQ and STQ), "need roughage — fur or feathers" (EQ and STQ), "Pal with chicken" (NQ).

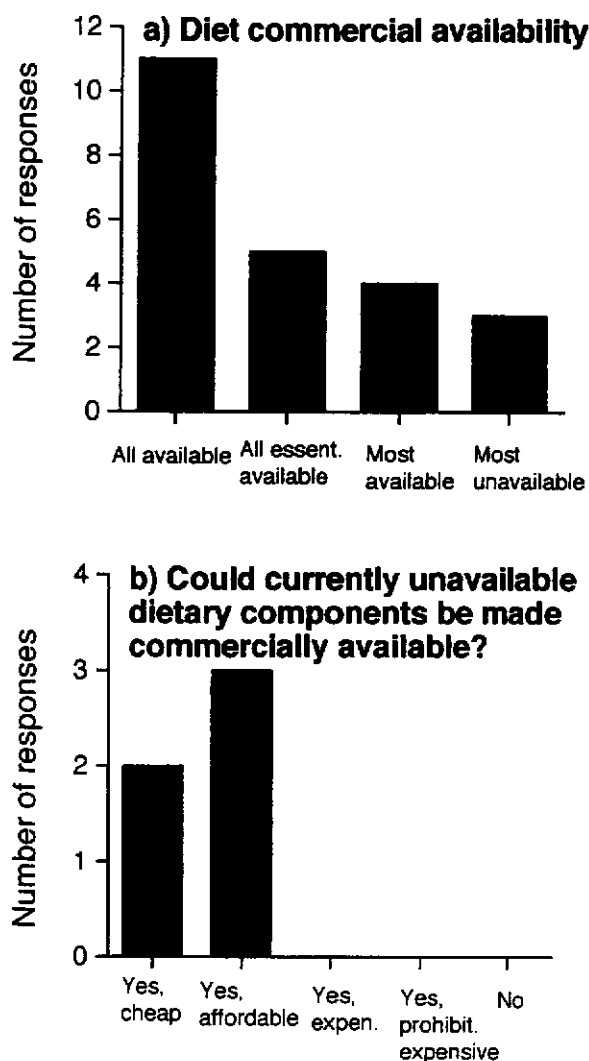


Figure 2. The responses regarding diet. a) Whether foodstuff is commercially available ( $n = 23$ ). b) For those respondents who considered that not all of the diet is commercially available, whether those foodstuffs could be produced commercially and made available through a retail outlet ( $n = 5$ ).

### Housing

*Briefly describe the type of housing you kept your animal in? How long were the animals kept in this enclosure?*

Housing ranged from the free run of the respondent's house to most commonly, enclosures of wire mesh with soil/sand mulch/sawdust/wood shavings substrate (wire base underneath). Some enclosures included galvanized iron walls or perspex walls. Of the 14 enclosures described, the mean dimensions were 2.5 m wide ( $\pm 1.2$  m), 4.6 m long ( $\pm 3.3$  m) and 2.2 m high ( $\pm 0.9$  m). The largest enclosure was 5 m wide, 10 m long and 2.5 m high. The smallest was 0.6 m wide, 0.6 m long and 0.45 m high. Quolls were kept in these enclosures for a mean of 970 days ( $\pm 726$ ,  $n = 10$ ). However, these enclosures

were designed for a variety of purposes including research, captive breeding and display and are not necessarily indicative of the appropriate housing for a pet.

Nest boxes were made of plywood or wood (caged quolls) or cardboard (house pet). Nest boxes ( $n = 12$ ) were on average 32 cm wide ( $\pm 12$ ), 51 cm long ( $\pm 24$ ) and 28 cm high ( $\pm 12$ ). The largest nest box was 50  $\times$  100  $\times$  50 cm (STQ) and the smallest was 10  $\times$  60  $\times$  10 cm (NQ). Other fixtures or "furniture" added in enclosures were platforms at 1 m or higher, access ramps and runways, climbing trees, hollow logs, branches, rocks, grass tussocks and nesting material (dry leaf litter).

Comments on housing and fixtures were "these animals need to be provided with large enclosures and plenty to do... rabbit cages or their equivalent... are not going to be adequate for the animal's requirements." (WQ). Also "I would hate to see them in rabbit hutches. They would be best off being given the run of the owner's house, perhaps being kept in the laundry when their presence is not wanted" (NQ). Also "it had the run of the house and back yard" (WQ), "the more space the better" (WQ), "they love lying in front of heaters" (NQs in southern Australia), and "we let them roam about our rooms and had no trouble putting them back in their cages" (NQ).

*Are there special housing requirements on which quolls depend for both physical and psychological well being? In terms of cost, how difficult do you estimate it to be to provide the housing requirements of quolls? How much does it cost to house a single quoll?*

All respondents considered that quolls had simple housing requirements with fixtures (nest boxes, feed and water devices) either commercially available or readily constructed from commercially available materials ( $n = 20$ ; Fig. 3a).

In relation to cost of housing the modal response was that quolls were "affordable to house" ( $n = 14$ ; Fig. 3b). No respondents considered them prohibitively expensive or impossible to house. For the 13 calculated and estimated costs of housing given, two were \$0.00 (house-pets), six were between \$0 and \$499, two were between \$500 and \$1,000 and three were over \$1,000 (\$2,500, \$4,000 and \$20,000), the latter being part of a commercial nocturnal house to allow public viewing.

*Excluding food and housing costs, how would you categorize the other costs (e.g., veterinary) associated with keeping these native mammals? Please estimate associated management costs per quoll per annum in an urban pet context.*

The modal response was "affordable" with 84% of respondents reporting that they were affordable or cheap ( $n = 19$ ; Fig. 3c). Estimated costs ranged from \$0 to \$1,500 per annum. This maximal figure included labour costs in a wildlife park so would be

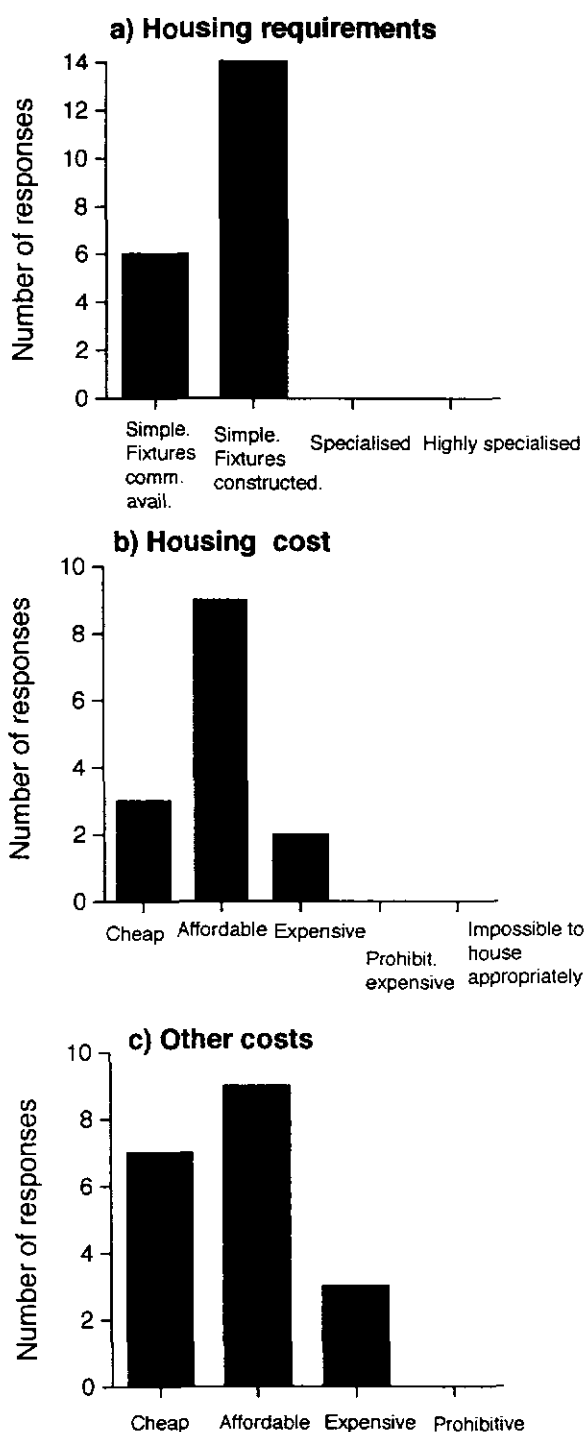


Figure 3. The responses regarding housing and other costs. a) Whether housing requirements were simple (commercially available or readily constructed), specialized or highly specialized ( $n = 20$ ). b) Whether housing was cheap, affordable, expensive, prohibitively expensive or impossible ( $n = 14$ ). c) Whether other costs were cheap, affordable, expensive or prohibitive ( $n = 19$ ).

inapplicable to pet owners. Hence the figure is excluded for the calculation of the mean cost which was \$120.71, the mode was \$100 and the median \$75 per annum. All four respondents who kept quolls as house-pets considered other costs to be cheap, with three providing estimates of \$0, \$10.00 and \$60.00 per animal per annum. Two respondents commented that other costs would be similar to cats and dogs. Another stated that miscellaneous costs would be greater for hand-reared animals.

### Captive management

*How long does a quoll require for you to attend to its daily maintenance (feeding, watering, enclosure cleaning etc.) requirements? Do you consider quolls to be demanding on your time?*

The mean of responses was 19 minutes (range 5 to 75) required to attend to the daily maintenance of a quoll ( $n = 20$ ; Fig. 4a). The mean time given by the four respondents who kept quolls as house-pets was nine minutes. Quolls were considered to be "occasionally" or "rarely" demanding on time by 90% of respondents ( $n = 21$ ; Fig. 4b).

*Is specialist attention (e.g., veterinarian, zoologist) required to manage these quolls? Did you, or any other handlers, suffer from any adverse health effects (allergy, viral, bacterial, fungal infection) as a consequence of handling the animals?*

The modal response was that specialist attention was "occasionally" required, with 90% of responses being "occasionally" or "no/rarely" ( $n = 21$ ; Fig. 5a). There were no detected human health problems such as allergies or infections from handling the animals ( $n = 21$ ; Fig. 5b). One respondent noted that dusting for mites and worming was required regularly. Fleas were mentioned by two respondents.

*Does the animal vocalize with sufficient loudness, duration, repetition to disturb a domestic household?*

Eighty-seven per cent of all responses (including all house-pet keepers) reported that quolls "never" or "rarely" vocalized with sufficient loudness/duration to disturb a household ( $n = 23$ ; Fig. 6a). It was noted by one respondent that they frequently vocalized during the breeding season, especially if a male and female are housed together (WQ).

*Does the animal smell (body odour, scent marking odour, general enclosure odour)?*

The modal response was that quolls had detectable but not objectionable body odour ( $n = 23$ ; Fig. 6b), although the full range from "none" to "objectionable" was recorded. One respondent considered that the odour from

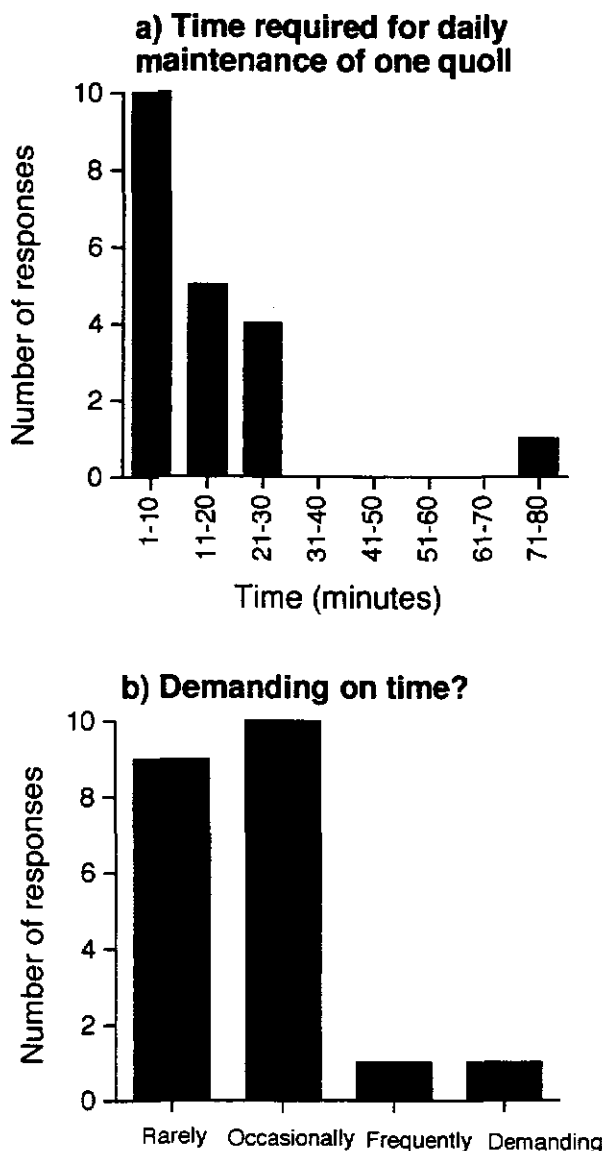


Figure 4. The responses regarding captive management. a) The time required for daily maintenance of one quoll (feeding, watering, enclosure cleaning;  $n = 20$ ). b) Whether respondents considered quolls to be demanding on their time ( $n = 21$ ).

the latrine area and territorial marking was objectionable (NQ). Another commented that the odour depends on how well the cage is maintained (NQ). A third who commented on this issue stated that "Quolls all *easily* train to use kitty litter boxes if kept indoors. They *want* to use them." (WQ, respondent's emphasis).

*Do you think that the animals if kept in an urban environment will cause problems through property damage (digging, scratching, scent marking, excretory habits or mating behaviours)?*

The modal response was no property damage, however 52% anticipated occasional minor, frequent minor or frequent serious

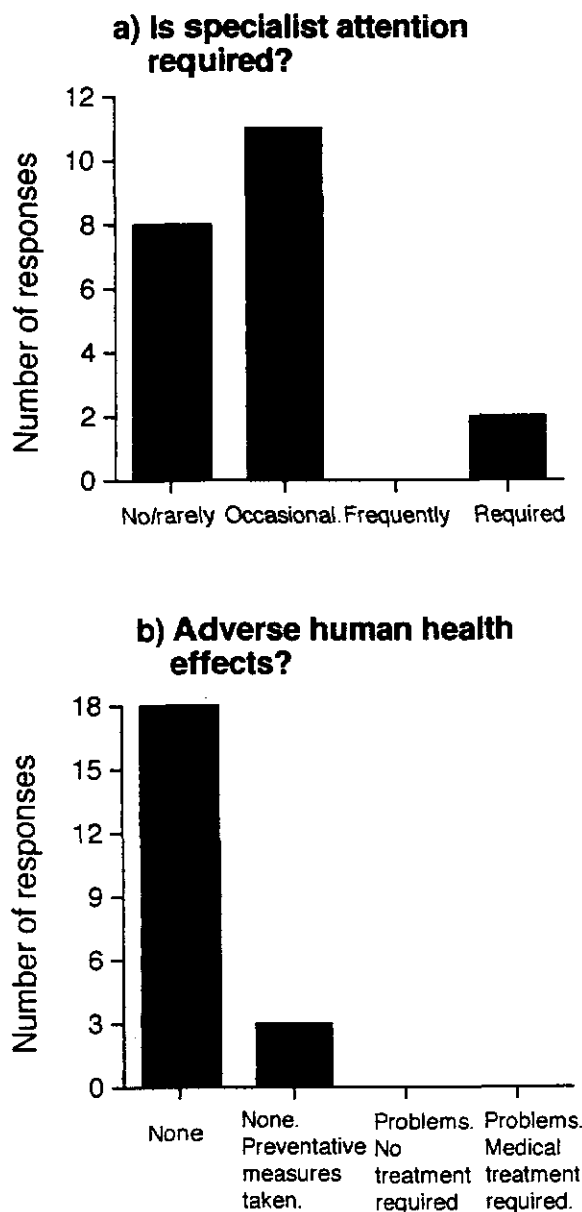


Figure 5. Additional responses regarding captive management. a) Whether specialist attention (e.g., veterinarian, zoologist) was required to manage quolls ( $n = 21$ ). b) Whether any handlers suffered any adverse health effects (allergy, viral, bacterial, fungal infection) as a result of handling quolls ( $n = 21$ ).

antisocial or property damaging behaviour ( $n = 23$ ; Fig. 6c). Obviously the extent is limited by housing. The responses by house-quoll keepers were none ( $n = 3$ ) or occasional ( $n = 1$ ). Behaviours observed were "chewing cupboard doors and piddling on possessions when running free in the house at night (NQ), marking territory and establishing nest areas" (NQ), "digging, excretory habits" (EQ), "aggressive-fighting" (NQ), scratching and biting (WQ), "will kill any and all animals up to the size of chickens if not contained appropriately" (WQ). In relation to behaviour towards other pets one respondent noted

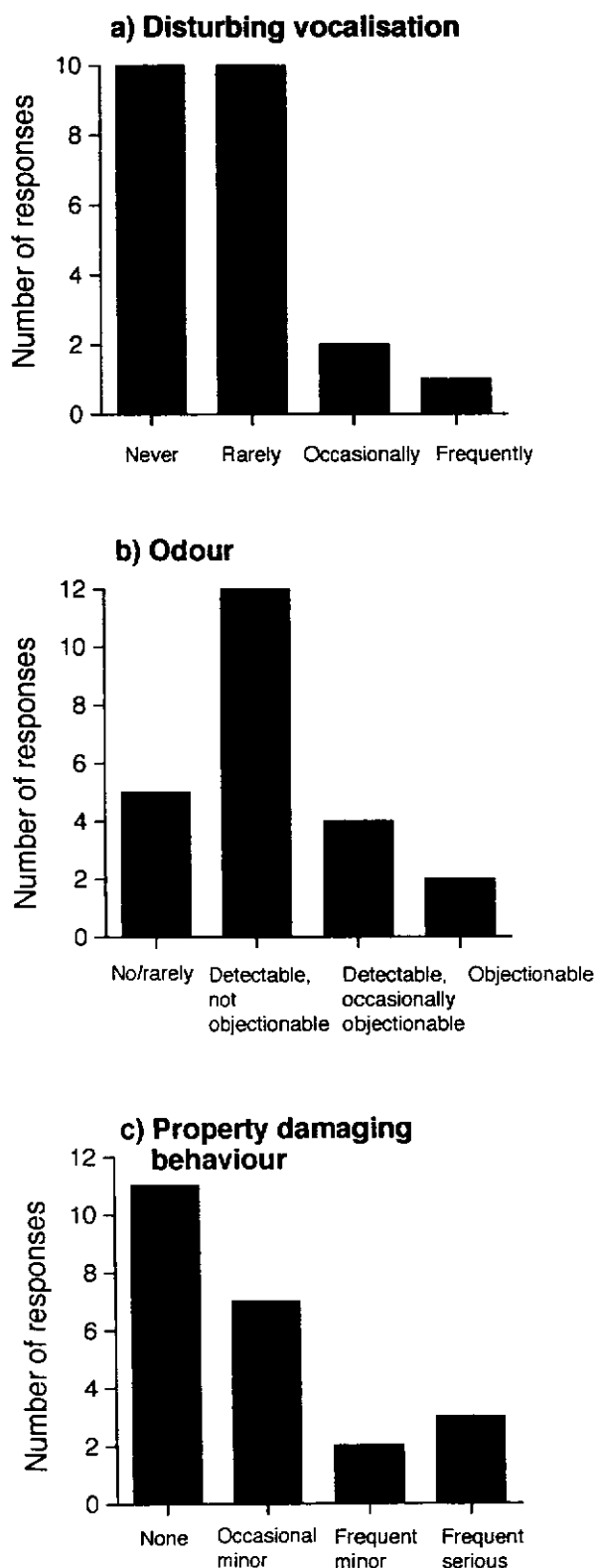


Figure 6. Additional responses regarding captive management. a) Whether quolls vocalized with sufficient loudness/duration/repetition to disturb a domestic household ( $n = 23$ ). b) Whether quolls were smelly (body odour/scent marking odour, general enclosure odour;  $n = 23$ ). c) Whether quolls kept in an urban environment will cause problems through property damage, excretory habits or mating behaviours ( $n = 23$ ).

that "I had them (cats) at the same time" (WQ house-pet). Two respondents who had experience only with wild quolls (in the field) anticipated that property damage would occur due to quolls being inquisitive and agile and reckless climbers (both STQ).

*Do you consider that quolls breed prolifically enough to be commercially bred for sale as a pet animal?*

The modal response was "disagree as difficult to breed", although the full range of responses were represented from "strongly disagree" to "strongly agree" ( $n = 20$ ; Fig. 7). When the subset of respondents who had personally managed captive colonies and successfully bred captive quolls was considered, a similar pattern was obtained although the number of responses "agree" and "disagree" were equal. This question is largely subjective as the viability would also depend on demand, sale price, costs etc.

*Calculate the number of weaned offspring per female per year for the colony you supervised or estimate the number of weaned offspring per female per year for the species.*

All four Australian quoll species breed only once per year. Extant Eastern, Spotted-tailed and Western Quolls are limited to a maximum number of six young by possessing only six teats (Edgar and Belcher 1995; Godsell 1995; Serena and Soderquist 1995). The mean number of weaned offspring per female per year estimated for these three species combined in this survey was 3.75 (calculated,  $n = 2$ ) and 3.8 (estimated,  $n = 7$ ). Northern Quolls, in contrast have variable teat numbers but the most common is eight (Oakwood 1997). The number of weaned offspring per female per year for this species recorded by respondents was 7 (calculated,  $n = 4$ ) and 5.5 (estimated,  $n = 3$ ). However, young female Northern Quolls (in their first breeding season) tend to have larger litters than old females (second season; Oakwood 1997). No wild female has been observed to breed more than twice. The other quoll species appear to show the same trend. Comments on captive quolls were "first year females were far more successful in having young" (EQ, STQ) and "A female quoll breeds in her first year, rarely in her second year and never in her third year. If a female quoll doesn't breed in her first year she will never breed" (EQ).

### Animal welfare

*Did your quoll thrive in captivity? Did you observe stressed or fearful behaviours in your quolls?*

Ninety-five per cent reported that quolls "thrived in captivity" or were "physically and

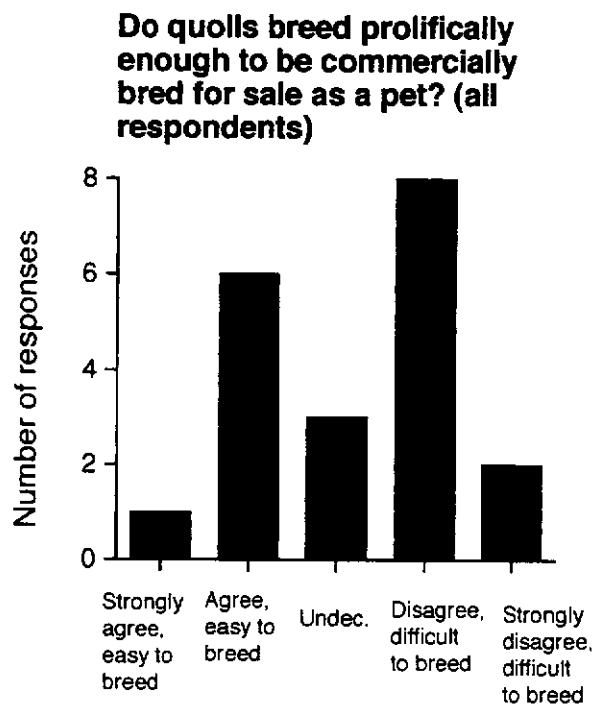


Figure 7. Respondents views on whether quolls breed prolifically enough to be commercially bred for sale as a pet (n = 20).

psychologically healthy with occasional minor problems" (n = 22; Fig. 8a). One respondent reported persistent minor problems with fleas. All respondents noted that quolls "never, rarely" or "occasionally" exhibited stressed or fearful behaviour (n = 20; Fig. 8b). One respondent noted that "quolls were never or rarely stressed as long as they were captive bred. Wild-caught animals held for breeding purposes showed highly repetitive boundary running behaviour." (WQ). Another respondent observed that quolls were always slightly stressed but captive raised were less stressed than wild caught (WQ). It was noted that there is a tendency to obesity in captivity (STQ, NQ).

*In considering the overall welfare of quolls, do you agree that they are suitable as pet species?*

Respondents were polarized about whether quolls are suitable as pet species (n = 23; Fig. 8c), with 61% disagreeing and the rest agreeing. No respondent held no view. One respondent who disagreed stated that "would be a rare person who could care for a quoll properly and enjoy its company as a 'pet'" (WQ). All of the respondents who had kept them as house-pets believed that they were suitable as a pet species (three of them strongly agreed). Respondents that had experience with captive quolls emphasised that quolls are only suitable for pets if hand-raised (EQ, EQ and STQ) and/or kept as house-pets (EQ, NQ, EQ).

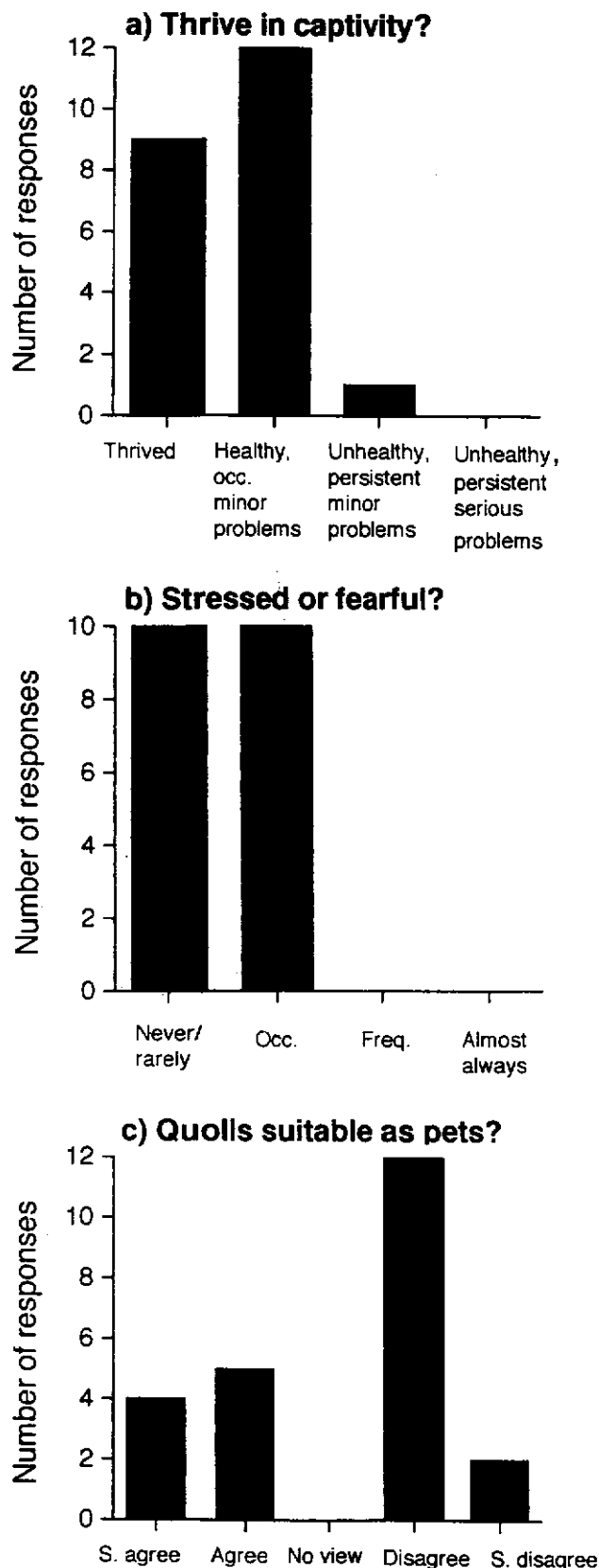


Figure 8. Responses regarding animal welfare issues. a) Whether the quolls thrived in captivity (n = 22). b) Whether stressed or fearful behaviours were observed in the quolls (n = 20). c) Respondents views on whether, considering the overall welfare of quolls, they are suitable as a pet species (n = 23).



## Pet keeping

*Do you agree in principle that traditional animals (e.g., dogs, cats, rabbits, rats, mice) should be commercially bred to be made available as pets? Do you agree in principle that some native mammals should be commercially bred to be made available as pets?*

All respondents believed, in principle, that some mammals should be commercially bred to be made available as pets. However, some believed that traditional animals (e.g., cats, dogs) should not be available while others believed that native animals should not. Respondents demonstrated wide variation in views about whether, in principle, traditional animals should be commercially bred to be made available as pets ( $n = 18$ , Fig. 9a). The views ranged from strongly disagree to strongly agree with the modal response being "agree".

Most respondents agreed or strongly agreed that some native mammals should be commercially bred to be made available as pets ( $n = 19$ , Fig. 9b). Some respondents emphasized that they consider only *some* species to be suitable. Three respondents disagreed or strongly disagreed.

*When comparisons are made between quolls and a domestic pet species of similar body size, does the quoll compare favourably as a pet?*

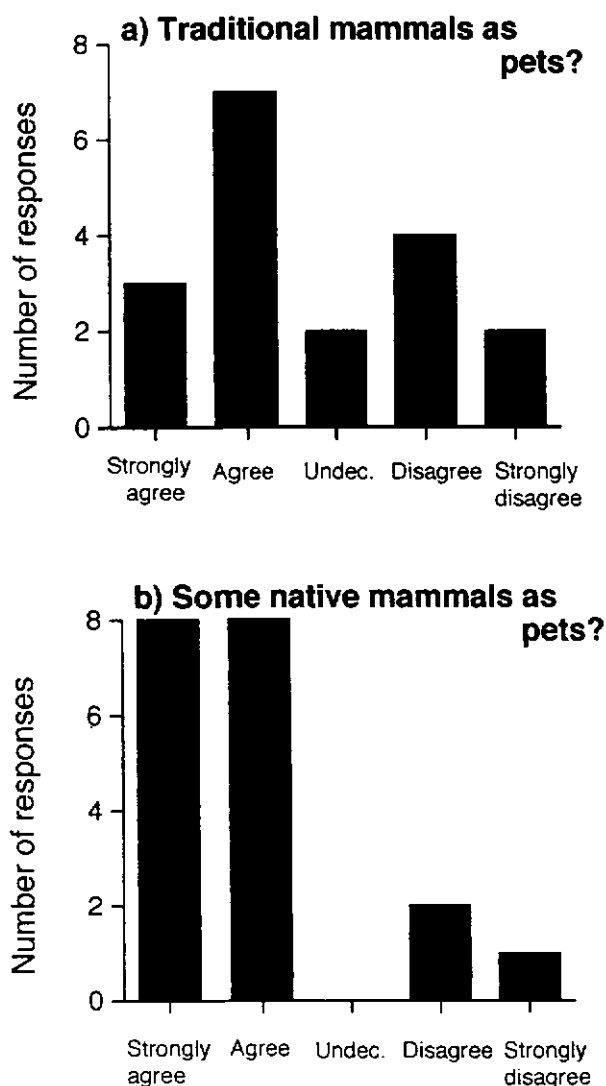
When compared to domestic pets of similar body size (Table 1), quolls were on average considered more favourable in aesthetic appeal, less noisy and less expensive. Quolls were similar to cats in ease of feeding, time involvement, ease of housing, odour and temperament. Quolls were less favourable than cats in companionship, playfulness and ease of handling.

## DISCUSSION

In this survey, opinions were sought from scientists, zookeepers and wildlife carers on

**Table 1.** Relative favourability of quolls compared to domestic pets of similar body size (90% of respondents compared quolls to domestic cats). Score: 5 = Very favourable, 4 = Favourable, 3 = Similar appeal, 2 = Unfavourable, 1 = Very unfavourable.  $N = 21$  for all attributes except overall cost where  $n = 20$ .

Characteristic	Mean	Mode	Range
Aesthetic appeal	4.3	5	2 to 5
Noise	3.9	4	2 to 5
Overall cost	3.6	3	2 to 5
Ease of feeding	3.4	3	3 to 5
Time involvement	3.2	3	2 to 5
Ease of housing	3.0	2.5	1 to 5
Odour	3.0	4	1 to 5
Temperament	2.7	2	1 to 5
Companionship	2.3	1	1 to 5
Playfulness	2.3	1	1 to 5
Ease of handling	2.1	2	1 to 4.5



**Figure 9.** Respondents views on whether: a) in principle traditional animals should be commercially bred to be made available as pets ( $n = 18$ ). b) in principle some native mammals should be commercially bred to be made available as pets ( $n = 19$ ).

the attributes and requirements of quolls that may affect their suitability as household pets. Overall, there was broad agreement that essential dietary components are commercially available and relatively inexpensive and that housing requirements are simple and affordable. Housing built for quolls should be compliant with the relevant legislation in each state. Quolls were rarely demanding on time, specialist attention was only occasionally required, no adverse human health effects were detected, disturbing vocalizations were rare, and the quolls were mostly healthy and rarely stressed.

However, there was wide variation in response to other questions. These included ease of handling, aggression, odour, property damaging behaviour, whether quolls breed

prolifically enough to be made available as pets and whether quolls were suitable as pets from a welfare point of view. This variability appeared to be associated with variation within and between quoll species, the sensitivities and perceptions of the individual respondents and the management of the quoll both past (wild-caught or captive bred; hand-raised or raised by mother) and present (wild or captive; caged or house-pet).

Some variations in response could be accounted for by variation within and between quoll species. Respondents commented that handling and aggression varied with individuals. Between species, there was a slight trend towards Eastern Quolls showing the least aggressive behaviour and causing injury less often when they were aggressive. Of the four quoll species, Northern Quolls had most young per female per year and Spotted-tailed Quolls had the least.

Another source of variation in responses appears to be derived from the philosophical stance of the respondent to the issue of native animals as pets. The three respondents who were philosophically opposed to keeping any native species as pets, as would be predicted, opposed the keeping of quolls. Some of their responses were the most negative outliers in the graphs. Their concerns included the fate of unwanted animals and their offspring, controls on animal movement between states (presumably so they do not become naturalized outside their former biogeographic range), future hybridization of wild and "domestic" animals and monitoring of the welfare of privately owned animals. Conservation and welfare issues are relevant to any potential native pet species and would certainly have to be resolved for each species before legalised pet keeping should occur. Other concerns raised by respondents were that nocturnality and short lifespan may affect the suitability of quolls as pets. However, such characteristics would only serve to restrict their suitability to some people, rather than all. Different people desire different traits in their pets as is demonstrated by the incredible diversity of species already kept.

If we consider the opinions of the 16 respondents who approved in principle that some native species should be made available as pets; seven considered quolls to be unsuitable from a welfare point of view and nine considered some quoll species suitable. Three only agreed if the quolls are hand-raised and/or kept as house pets. This latter point appears to be the crux of the matter.

The main source of variation in responses, particularly for handling and aggression,

appeared to be correlated with the management history of the quoll. Wild quolls were the most aggressive and difficult to handle (in a pet sense), captive caged quolls (wild caught and captive bred) were intermediate, and quolls that were hand-reared or kept from a young age as a pet were the easiest. Of the four respondents with experience of quolls totally or partially as house-pets, all agreed (three strongly) that quolls were suitable (considering their overall welfare) as pets. Comments were "Hand reared quolls are very playful and delightful to handle... and rarely cause injury" (EQ), and that animals were more docile with frequent handling (NQ).

This notion that with daily human handling and contact (in a pet relationship) quolls become easier to handle is supported by the older literature. In the 1950s Troughton (1954) describes a Mr Grant who had Spotted-tailed Quolls in his house. He states that "the young one grew up with complete confidence in its captor... it would be completely at home sheltering in his arms and climbing around his shoulders". The captive quolls were described as clean and they became playful with pieces of clothing and other objects, like a kitten. The young quoll went on walks wearing a harness. Troughton concluded by stating "that the most successful results are achieved with animals reared in captivity or caught when very young" and one of the survey respondents commented that "they would make excellent house pets with extra understanding but need to be reared as young to adults to build up the friendship" (EQ).

In conclusion, although this survey had a limited sample size due to the current legislative restrictions on the keeping of native mammals by the public and the paucity of quolls kept by zoological institutions, there appears to be a trend whereby quolls may be suitable as house-pets. This view is supported by comments in the older literature. Consequently, the authors recommend that a pilot study be undertaken to clarify issues raised by the questionnaire. The study would need to be based on a captive breeding colony of quolls, the offspring from this colony could be placed with selected carers as trial house-pets. Eastern Quolls within the Sydney metropolitan region would probably initially be most appropriate as such a study would be within their former biogeographic range.

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## REFERENCES

- Bonnin, M., 1967. Observations on *Dasyurus viverrinus*. *SA Nat.* **42**: 29-31.
- Edgar, R. and Belcher, C., 1995. Spotted-tailed Quoll, *Dasyurus maculatus*. Pp. 67-69 in *The Mammals of Australia* ed by R. Strahan. Reed: Sydney.
- Fleay, D., 1945. Native cats at home: breeding carnivorous marsupials. *Wild Life* **7**: 233-37.
- Godsell, J., 1995. Eastern Quoll, *Dasyurus viverrinus*. Pp. 70-71 in *The Mammals of Australia* ed by R. Strahan. Reed: Sydney.
- Godsell, J., Arnold, J., Maisey, K., Mansergh, I. and Begg, R., 1984. Quolls. *Aust. Nat. Hist.* **21**: 250-55.
- Jones, M., 1996. Clash of the Carnivores. *Nat. Aust.* **25**: 46-55.
- Jones, M. E. and Barmuta, L. A., 1998. Diet overlap and relative abundance of sympatric dasyurid carnivores: a hypothesis of competition. *J. Anim. Ecol.* **67**: 410-21.
- Oakwood, M., 1997. The ecology of the Northern Quoll, *Dasyurus hallucatus*. Ph.D. thesis, Australian National University: Canberra.
- Serena, M. and Soderquist, T., 1995. Western Quoll, *Dasyurus geoffroii*. Pp. 62-64 in *The Mammals of Australia* ed by R. Strahan. Reed: Sydney.
- Troughton, E., 1954. The Marsupial "Tiger Cat". *The Aust. Mus. Mag.* **11**: 200-02.
- Wheelwright, H. W., 1979. *Bush Wanderings of a Naturalist*. Oxford University Press: Melbourne.
- Wiseman, S. C., 1945. Letter to "Along the Track". *Wild Life* **7**: 280.

Right: Mike Archer and house-pet Western Quoll in Perth.

Below left: Western Quoll house-pet. This quoll slept in the bureau in the background.

Below right: Pet Western Quoll and pet cat contemplate each other.

